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Hybrid digital workflow for optimal esthetics and gingival adaptation of the pontic in monolithic zirconia restoration

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When the gingival adaptation of monolithic zirconia pontic is inadequate, the post-insertion of porcelain is inevitable. This process is time-consuming, less predictable, and decreases the homogeneity of the monolithic zirconia restoration. In this report, a computer-aided design and computer-aided manufacturing (CAD/CAM) provisional resotration was fabricated and intraorally modifed to optimize the gingival adaptation. Then, the pontic design was digitally transferred to the definitive restorations by hybrid digital workflow, using silicone replica, intraoral scanning, and computer-aided superimposition techniques. The process optimizes the gingival adaptation of the pontic, thereby significantly enhancing the esthetic and biological functions of monolithic zirconia restoration. (THE JOURNAL OF KOREAN ACADEMY OF OSSEOINTEGRATION 2020;12(1):14-17)

Key words: Monolithic zirconia, Pontic, Gingival adaptation, Provisional restoration, Image superimposition

INTRODUCTION

Pontics are the artificial teeth of a fixed dental restoration, that replace missing natural teeth[1]. The ideal pontic design should fulfill the basic role of replacing the lost tooth, ensuring the mechanical stability of the restoration, achieving an esthetic appearance, and enabling adequate oral hygiene as well as compatibility with soft tissue[2,3]. It is essential to reproduce proper gingival contact of the pontic in order to provide tissue guidance and stabilization[2,4,5].

Various pontic designs have been described in the literature, including sanitary, modified sanitary, ridge-lap, modified ridge-lap, ovate, and conical shapes[3,6]. The pressure applied to the gingiva by the pontic should be well-controlled[5]. Hyperpressure to the ridge causes continuous gingival inflammation and difficulties in maintaining good oral hygiene[6,7]. On the other hand, loose gingival contact restricts esthetics and incurs plaque accumulation under the pontic[2], which could be a major factor contributing to restoration failure[3,6].

When the gingival misfit of the pontic is observed on the day of delivery of the definitive restoration, the tissue surface of the pontic should be modified in the clinic. Although the misfit can be eliminated by trimming excessive material or firing additional porcelain on the ridge-lap area[8-10], the post-treatment is time-consuming and empirical, possibly leading to unpredictable results. Moreover, in monolithic zirconia restorations, porcelain addition disturbs its homogeneity and induces surface roughness[7,9-11].

The purpose of this article is to introduce a hybrid digital approach to produce a monolithic zirconia restoration with an optimal gingival adaptation of the pontic using computer-aided design/computer-aided manufacturing (CAD/CAM) provisional restoration and computer-aided superimposition techniques.

CASE REPORT

A 52-year-old woman presented with a chief complaint of dissatisfactory esthetics relating to her smile. Treatment with a six-unit monolithic zirconia restoration with modified ridge lap design of the pontics was indicated in the anterior region of the maxilla. After tooth preparation (Figure 1), a final impression was recorded using light- and heavy-body vinyl polysiloxane (Virtual light body and heavy body regular, Ivoclar Vivadent, Schaan, Liechtenstein).

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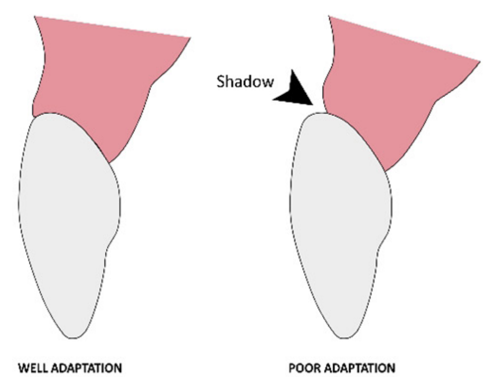
A master cast was made from type IV dental stone (Esthetic-rock, dentona AG, Wipperfurth, Germany), and scanned by a dental desktop scanner (IDC S1, Amann Girrbach, Koblach, Austria). The digitized data were transmitted to a CAD software program (IDC D1, Amann Girrbach) where a provisional restoration was designed and fabricated using a five-axis milling machine (IDC MILL 5X, Amann Girrbach) and a polymethyl methacrylate resin block (Vipi Block Trilux, VIPI, Pirassununga, Brazil).

Figure 1. Teeth preparation for zirconia restoration.

The provisional resin restoration was tried in the oral cavity, and the esthetics and adaptation were inspected. Loose gingival contact under the pontics was observed (Figure 2). The gap between the pontics and the gingiva was replicated by inserting light body impression material (Virtual Light Body Regular, Ivoclar Vivadent) in the space (Figure 3).

The corresponding edentulous ridge area was trimmed off in the master cast, with an extent of 10 to 15 mm, bucco-lingually[2], and the provisional restoration with a silicone replica was placed over the master cast. Dental stone material (Esthetic-rock, dentona AG, Wipperfürth-Hämmern, Germany) was inserted in the space between silicone and the trimmed ridge to modify the

A



B

Figure 2. Delivery of provisional restoration. (A) intraoral image, (B) schematic images illustrating the gingival adaptation of the pontics (arrowhead shows the shadows around the tissue surface).

A

B

Figure 3. (A) Insertion of light body silicone impression material under pontics and (B) silicone replicating the gap beneath the pontics.

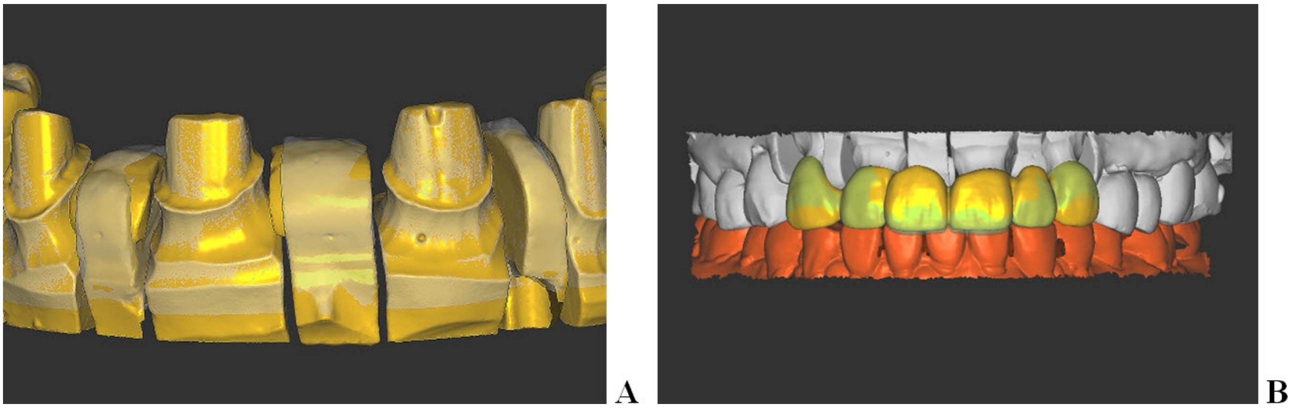


Figure 4. (A) Superimposed image of the digitized master casts before and after ridge modification and (B) design of the definitive restoration based on the modified provisional restoration.

Figure 5. (A) Delivery of the monolithic zirconia restoration and (B) favorable gingival adaptation of the pontics.

master cast. The revised master cast was re-scanned, and the image was superimposed on the first scan image of the cast using the best-fit function in the software program (IDC D1, Amann Girrbach) (Figure 4A). Based on the new ridge form, the pontic design of the restoration was modified (Figure 4B). A monolithic zirconia restoration was fabricated using a five-axis milling machine (IDC MILL 5X, Amann Girrbach) and a monolithic zirconia block (Ceramill zolid, Amann Girrbach).

The fit of the pontic of the definitive restoration was evaluated before cementation using the silicone application. The gap under the pontic was successfully removed, and the patient was satisfied with the esthetics and adaptation of the zirconia restoration (Figure 5).

DISCUSSION

Provisional restorations play a strategic role in the fabrication of definitive restorations in terms of esthetics and function[12]. Especially when computer-aided techniques are applied, the beneficial effects of using provisional restorations are maximized[12,13]. In the treatment with monolithic zirconia restoration, the virtual design drawn by the computer software program can be used for both the provisional and definitive restorations. Accordingly, the CAD/CAM provisional restoration becomes the direct reference for estimating the prognosis of the definitive restoration[14-16]. Moreover, the initial design can be shaped to accommodate the clinical requirements and patient satisfaction collected during the provisional restoration use. In this article, image superimposition and computer designing tools have been used to modify the tissue surface of the pontics of the provisional restoration, to ensure a perfect fit of the definitive restoration. The scanned files were registered using dental software. The workflow was straightforward and convenient for the dentist and dental technicians to fabricate pontics with contours fitting the underlying ridge.

The importance of gingival adaptation of the pontic has been emphasized[17-19]. Unfavorable gingival adaptation may compromise the results of definitive restorations[6]. Although special attention is given in recording the impression of the alveolar mucosa, misfit of the pontic still occurs because of soft tissue change or laboratory mistakes[4,14]. Recently, computer-aided technology has been used to record and transfer the impression of the tissue receptor site of the pontic to the master cast and to replicate it into the definitive restoration[2,16]. The hybrid digital workflow in this article combines the conventional and digital approaches to represent the clinical appearance of the soft tissues. The condition of the soft tissues beneath the pontic was directly replicated to the master cast, thus reducing the errors and hampering the creation of an ideal gingival contact.

The hybrid workflows certainly shown the advantages of efficient recording and transfer of the clinical residual ridge information. When the workflow of the present article is applied in a monolithic zirconia restoration, the gingival adaptation is more predictable, thus, the post-modification may be eliminated. Further studies on the accuracy and precision of the scanning and image superimposition process will be needed to expand the application of this technique.

CONCLUSION

The CAD/CAM provisional resin restoration combined with the digital superimposition technique is an effective method to replicate the tissue receptor site of the pontic and transfer the information from the provisional to the definitive restoration. This approach creates the possibility of optimization of the gingival adaptation of the monolithic zirconia restoration in a feasible and straightforward manner.

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